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BEKASI-EAST JAKARTA AIRPORT
GROUND SIDE

Report

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1 | Prognosis

1.1 Aviation context in Indonesia

Indonesia is the fourth most populated country in the world and the largest economy in south-east Asia. Indonesia is also, a growing touristic destination because its outstanding nature marvels and cultural monuments. It's topography which is composed by many island makes essential the domestic air transport.

Jakarta (located at the island of Java) is the centre of government, commerce and industry of Indonesia. Currently Jakarta has an international airport (Soekarno-Hatta International Airport). It operates around the 250% over its design capacity and an interesting fact is that last year 40% of its flights were delayed. Efforts have been made to decrease this problem opening a small military airport for civilian domestic flights. Nevertheless, the problem still persists.

The current Jakarta airport cannot be expanded, due to nearby neighbourhoods. "Some news have been recently published by Jakarta authorities confirming the urge of a new airport around Jakarta to absorb the saturated traffic of the Soekarno-Hatta International Airport, even after constructing a new runway and terminal on it.

All in all, it is essential to construct a new airport. Moreover, the secondary airport, really small, is only focused on military and private services and does not have enough fields at its surroundings to expand, as Jakarta air traffic requires.

1.1.1 Airport location

The main idea to find a good location was to put the new Jakarta airport in an area not too far from the city with enough space to build a big airport which has opportunities to expand in a further future.

Following this parameters, the location chosen geographically is situated to the east of the city of Jakarta at 32 km from the city center. It is also located above the emerging city of Bekasi that in the last years is increasing its industry hosting several multinationals. In addition, the terrain is not edified yet and extensive, plus it is non-mountainous and obstacles-free.

Figure 1.1.1: Bekasi-East Jakarta Airport selected location.

It is a huge free obstacle flat field, without relevant slope gradients and the terrain is not edified yet. It is an exceptional location due to its huge amount of terrain available where companies could settle down taking advantage of the airport proximity, low terrain costs and direct connection with the down town. There is enough space to become also a logistic distribution centre of the island and Indonesia.

Finally, as it is an almost virgin land, communication is limited. Therefore, the solution is easy. The present Jakarta motorway will be extended. As it is shown on Fig. 1.1.1 indicated with a discontinuous line, there will be two connections between the current and the new highway.

Connection between airports will be achieved thanks to this new built highway. It will take 40min from door to door. Connection network of free-busses between both airports will make transfers safe and easy. There will be also available buses to and from the city centre, at low prices. During rush hours, a specific way will be delimited only for airport bus transfers.

1.1.2 Current traffic

The starting point has been Soekarno-Hatta Airport. As it can be seen on fig.1.1.2, currently Soekarno-Hatta Airport is handling volumes of passengers around 50 million passengers by year.

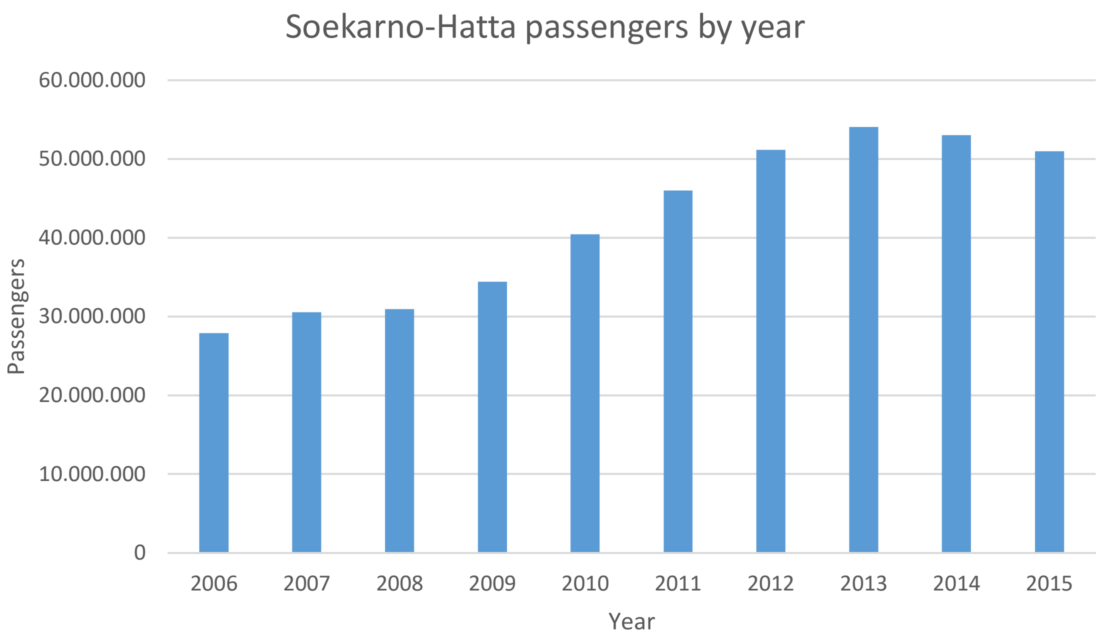

Figure 1.1.2: Soekarno-Hatta International Airport passengers by years

Operations on a mean day have the following pattern:

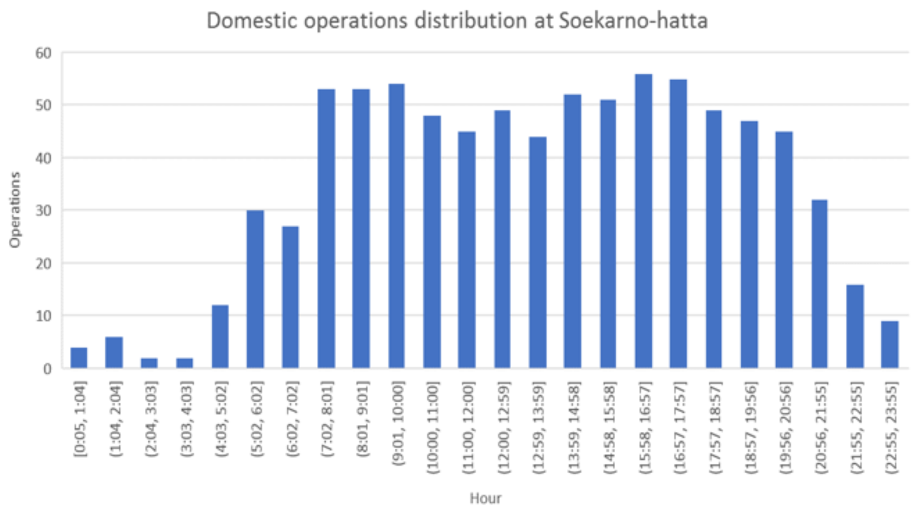

Figure 1.1.3: Soekarno-Hatta International Airport domestic flights distribution on busy day.

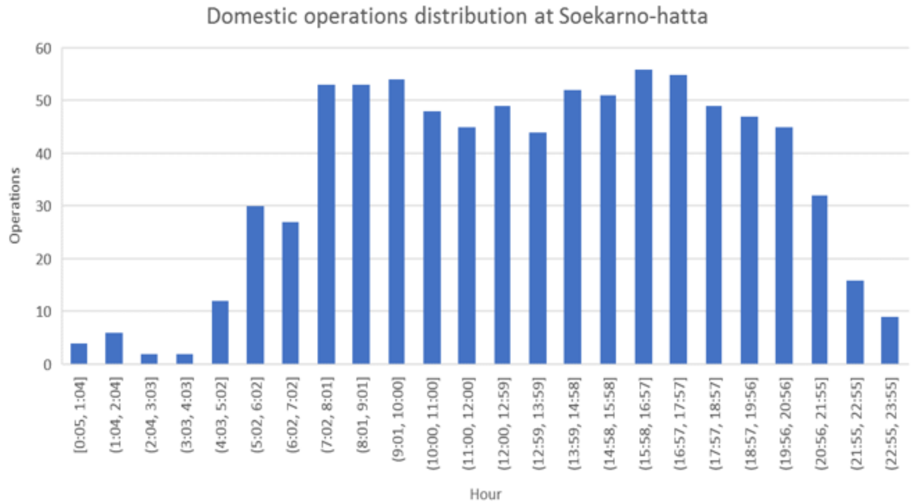

Figure 1.1.4: Soekarno-Hatta International Airport domestic flights distribution on busy day.

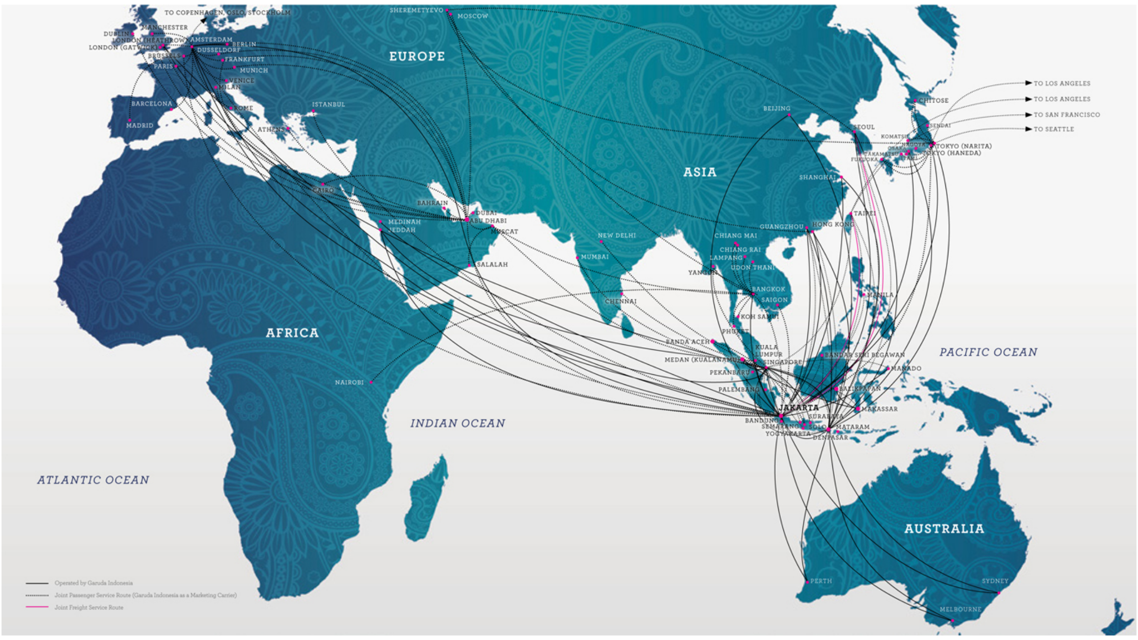

Figure 1.1.5: Soekarno-Hatta International Airport routes

1.1.3 Occupation factor

1.2 Reference aircraft

Hola

1.2.1 Aircraft type

1.2.2 Conclusions

1.3 Forecast computation

In order to do a realistic study for the new Bekasi-East airport traffic, it is previously established the Soekarno-Hatta International Airport (CGK) as the reference airport for future operations prevision. According to one of the IATA main recommended methods for the elaboration of traffic previsions, data from historical series of CGK traffic has been used so as to be able to extrapolate the study horizons of the airport to be designed.

In order to do this, it is necessary to calculate the annual variation tendency of the different traffic parameters from historical data of the last years. Data mentioned is extracted from the "Directorate General of Civil Aviation" (DGCA) and "FlightRadar24" web pages.

With this information, the next step is to calculate the values of horizon scenario, which has been fixed in 15 years with respect to the airport inauguration (it is expected to be finished in 2020). The horizon scenario will be fixed then in 2035.

Before starting the study of passenger and operation demands, some important aspects will be taken into account:

- The airport to be projected will absorb nearly the 40% of CGK's current traffic, which corresponds to the percentage of delayed flights due to congestion.
- The growth tendencies, concretely the Compound Annual Growth Rate (CAGR), has been calculated using the data corresponding to the five more recent years. The expression used to calculate the values is the following one:

$$CAGR = \left(\frac{V_{fin}}{V_{ini}}\right)^{\frac{1}{t_{fin}-t_{ini}}} - 1 \tag{1.3.1}$$

- The prediction of passengers and operations have been calculated using three possible scenario.
  - Neutral scenario: The growth is constant along time. This neutral scenario has been used to estimate the number of passengers and operations in 2035.
  - Optimistic scenario: The growth is constant along time but in 2025 is multiplied by a factor of 1,5 due to, for example, a boom of tourism in the city.
  - Pessimistic scenario: The growth is constant along time but in 2025 is divided by a factor of 2 due to, for example, a period of time with adverse atmospheric phenomena.

In addition, both the airlines as well as the percentage of operations absorbed from CGK are detailed in the following table:

AIRLINES	% OPERATIONS
Garuda	31.62
Citilink	7.11
Emirates	0.35
Etihad	0.44
Qatar	0.53
Total	40.05

Table 1.3.1: Airlines absorbed and operation percentages from CGK.

1.3.1 Passenger prediction

In this section it will be calculated the number of annual passenger both domestic and international in the horizon scenario in 2035.

Taking into account the historical passenger data collected from CGK airport, one can obtain:

Year	Domestic PAX	International PAX	Total PAX
2011	35.412.018	10.589.310	46.001.328
2012	39.499.760	11.674.136	51.173.896
2013	41.318.616	12.743.330	54.061.946
2014	40.531.384	12.489.680	53.021.064
2015	38.262.800	12.696.766	50.959.566

Table 1.3.2: Volume of passengers of the last 5 years in CGK Airport.

The CAGR's calculated from data in the table above:

- CAGR for Neutral Scenario

Type	Initial Value	Final Value	PAX CAGR
Domestic	35.412.018	38.262.800	1,95%
International	10.589.310	12.696.766	4,64%

Table 1.3.3: Neutral scenario passenger CAGR.

- CAGR for Optimistic and Pessimistic Scenario (applied from 2025)

Using the growth taxes computed previously, it is obtained the following results in horizon scenario.

Type	Optimistic PAX CAGR	Pessimistic PAX CAGR
Domestic	2,93%	0,98%
International	6,96%	2,32%

Table 1.3.4: Optimistic and pessimistic scenario passenger CAGR.

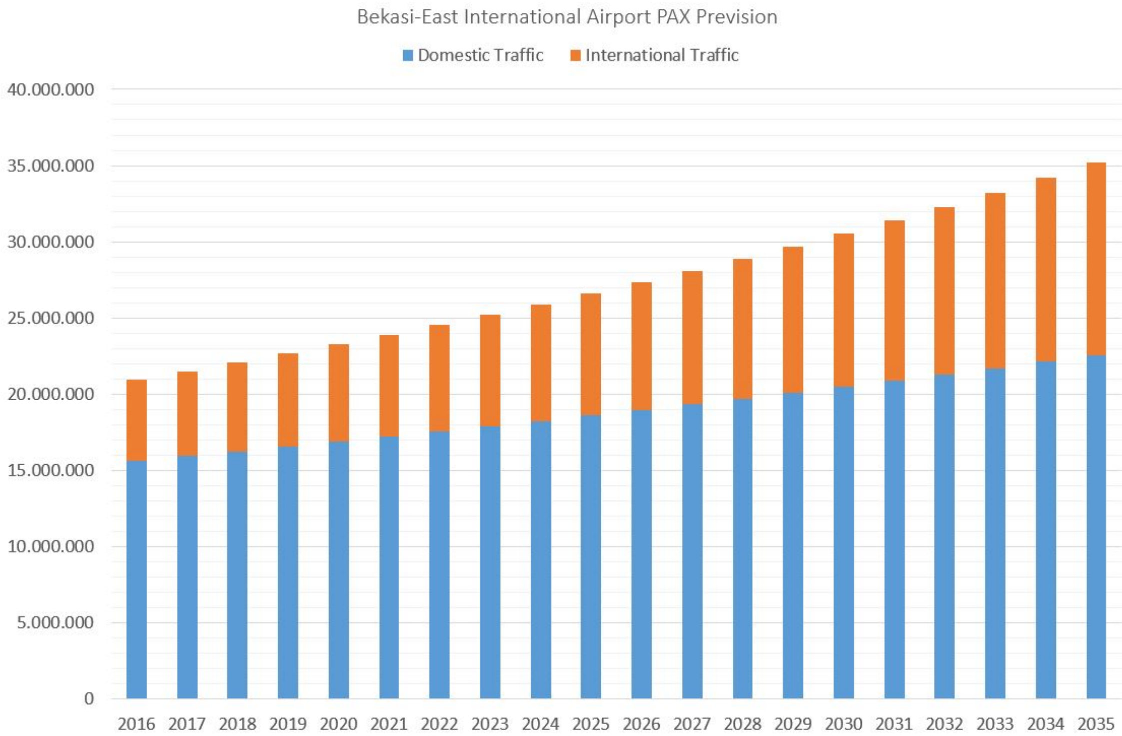

Figure 1.3.1: Bekasi-East Jakarta Airport passenger prevision.

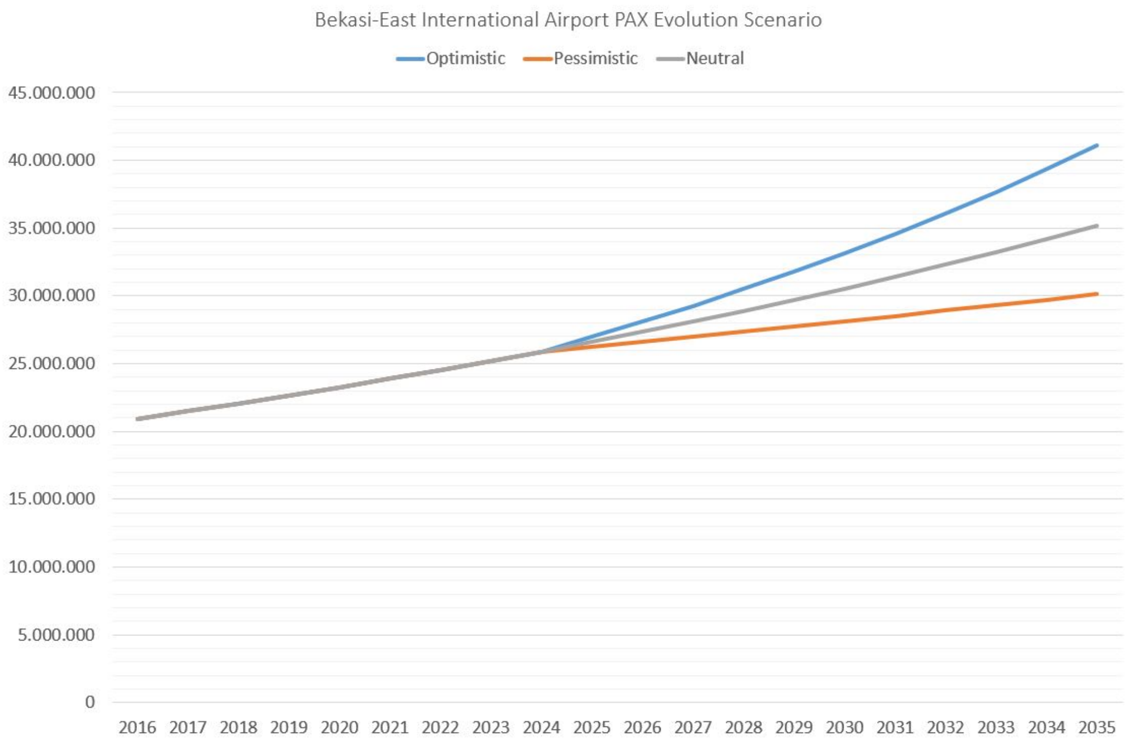

Figure 1.3.2: Bekasi-East Jakarta Airport passenger prevision for neutral, optimistic and pessimistic scenario.

1.3.2 Operations prediction

In this section it will be calculated the number of annual operations both domestic and international in the horizon scenario in 2035.

Taking into account the historical operations data collected from CGK airport, one can obtain:

Year	Domestic OPS	International OPS	Total OPS
2011	279.668	68.241	347.909
2012	327.416	79.288	406.704
2013	329.568	82.924	412.492
2014	331.120	115.184	446.304
2015	301.696	84.919	386.615

Table 1.3.5: Volume of operations of the last 5 years in CGK Airport.

The CAGR's calculated from data in the table above:

- CAGR for Neutral Scenario
- CAGR for Optimistic and Pessimistic Scenario (applied from 2025)

Type	Initial Value	Final Value	OPS CAGR
Domestic	279.668	301.696	1,91%
International	68.241	84.919	5,62%

Table 1.3.6: Neutral scenario operations CAGR.

Type	Optimistic OPS CAGR	Pessimistic OPS CAGR
Domestic	2,87%	0,96%
International	8,43%	2,81%

Table 1.3.7: Optimistic and pessimistic scenario operations CAGR.

Using the growth taxes computed previously, it is obtained the following results in horizon scenario.

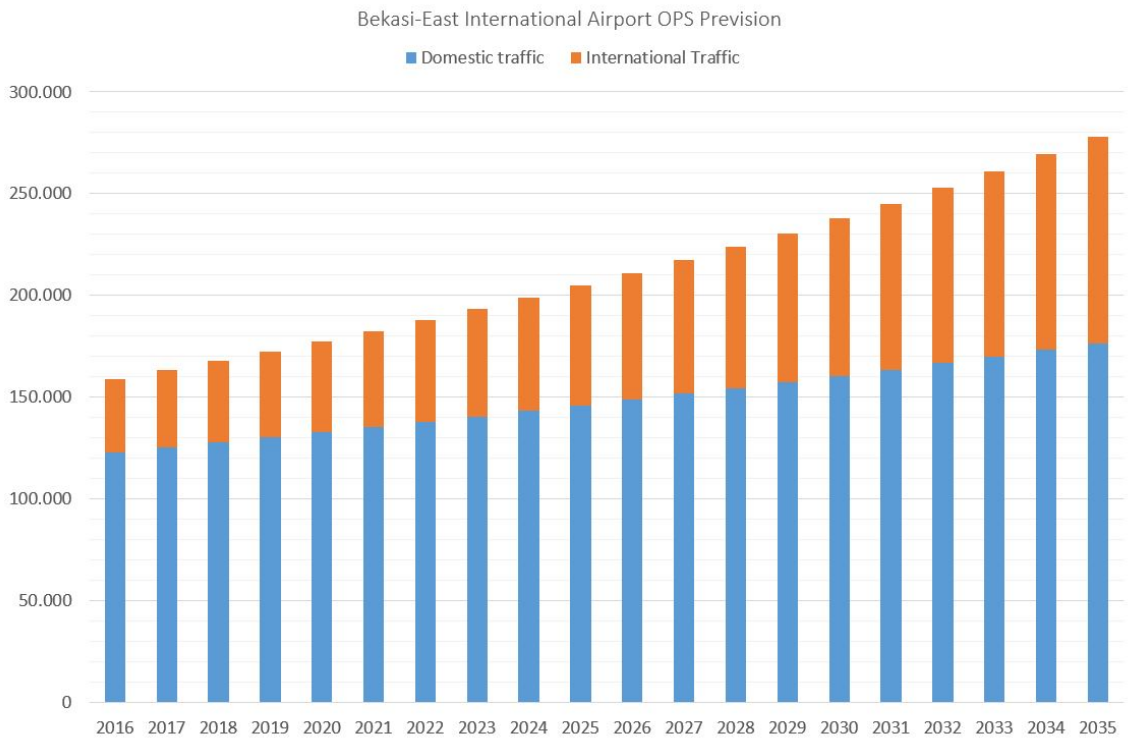

Figure 1.3.3: Bekasi-East Jakarta Airport operations prevision.

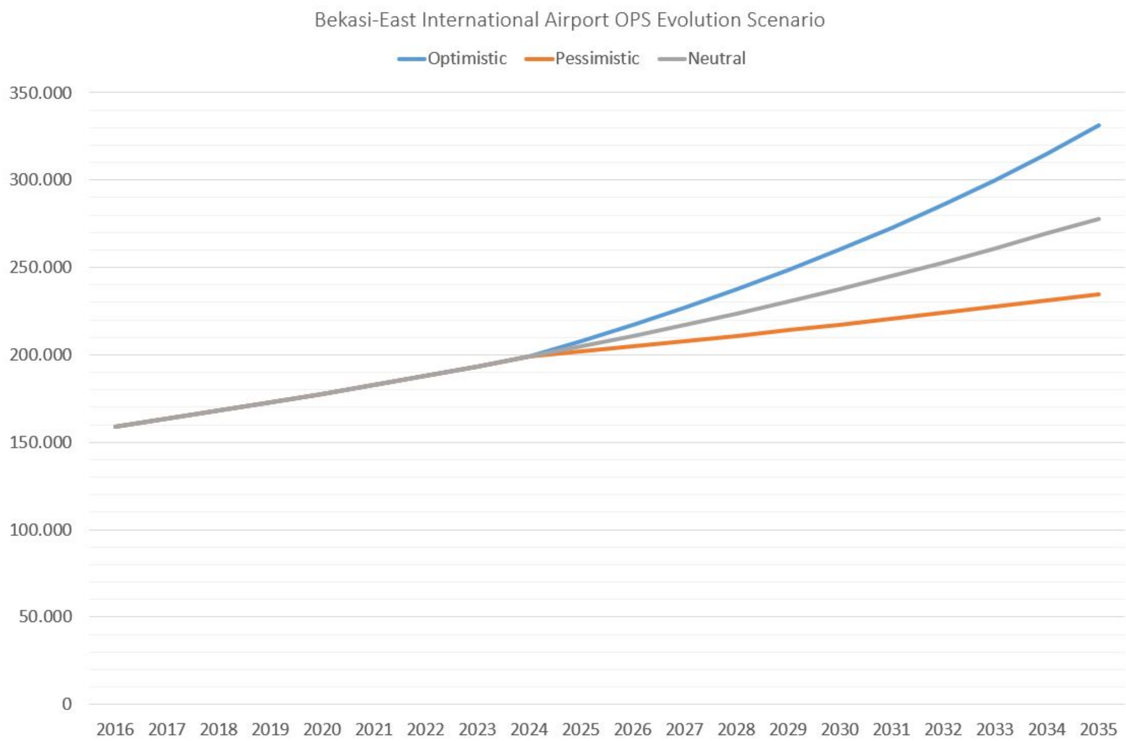

Figure 1.3.4: Bekasi-East Jakarta Airport operations prevision for neutral, optimistic and pessimistic scenario.

1.3.3 Flights on busy day

The total number of passenger and operations calculated for the horizon scenario in 2035 are:

Traffic in 2035	
Passenger	35.170.379
Operations	278.011

Table 1.3.8: Traffic of Bekasi-East Jakarta Airport in 2035.

IATA defines the busy day as the second busiest day in an average week during the peak month. An average weekly pattern of passenger traffic is calculated for that month. Peaks associated with special events such as religious festivals, trade fairs and conventions, and sport events, are excluded.

Having 2015 busy month values of passenger and operations for CGK airport and the total year values, the percentage of peak above mean can be calculated. Supposing this percentage above mean is conserved along time, it is easy to extrapolate the number of passenger and operations in busy day for the new Bekasi-East Airport. The following results are obtained:

With the number of maximum hourly operations and an utilisation factor of 77% for both domestic and international flights, the number of maximum passenger per hour in the airport

Bekasi-East Jakarta Airport PAX in 2035			
Type	Domestic	International	Total
Total Year	2.233.960	1.253.000	3.486.960
Mean Month	22.568.860	12.601.519	35.170.379
Mean Day	1.880.738	1.050.127	2.930.865
Busy Day	73.778	41.009	114.787

Table 1.3.9: Determination of number of passengers in busy day.

Bekasi-East Jakarta Airport OPS in 2035			
Type	Domestic	International	Total
Total Year	176.525	101.486	278.011
Mean Month	14.710	8.457	23.168
Mean Day	484	278	762
Mean Hour	24	14	38
Max Hour	30	20	50

Table 1.3.10: Determination of maximum number of operations per hour.

is calculated.

Bekasi-East Jakarta Airport Peak Hour			
Type	Domestic	International	All
Utilisation Factor	77%	77%	-
Max PAX/OPS	189	189	-
PAX/OPS	146	146	-
Max PAX/H	4.394	2.870	7.264

Table 1.3.11: Determination of the peak hour passenger value.

2 | Terminal building distribution

2.1 Basic dimensions of the terminal building

2.2 Surface distribution

The terminal building interiors will be distributed according to the FAA criteria. This method has been chosen because it differentiates between domestic and international passenger flows, which are very well defined at this airport.

In order to manage and distribute the space available, the forecasted traffic predicted in the prognosis is to be used.

In first place, as shown in table **??**, the surface corresponding to domestic traffic is distributed. According to prognosis data, the number of domestic passengers at design hour will be of 4850.

Surface	% out of total	m2/pax	m2 total
Departures	0.0435	0.609	2953.65
Arrivals	0.0435	0.609	2953.65
Waiting lobby	0.0739	1.035	5019.75
Restrooms	0.013	0.183	887.55
Kitchens	0.0652	0.913	4428.05
Restaurants	0.0652	0.913	4428.05
Offices	0.1957	2.739	13284.15
Other	0.0217	0.304	1474.4
Circulation	0.4783	6.696	32475.6
TOTAL			**67904.85**

Table 2.2.1: Estimated surfaces according to FAA (domestic flights).

In second place, as shown in table **??**, the surface corresponding to international traffic is distributed. According to prognosis data, the number of international passenger at design hour will be of 3168.

Surface	% out of total	m2/pax	m2 total
Departures	0.0435	0.609	2953.65
Arrivals	0.0435	0.609	2953.65
Waiting lobby	0.0739	1.035	5019.75
Restrooms	0.013	0.183	887.55
Kitchens	0.0652	0.913	4428.05
Offices	0.1957	2.739	13284.15
Other	0.0217	0.304	1474.4
General circulation	0.307	6.145	19467.36
Immigration	0.042	0.838	2654.78
Customs	0.084	1.676	5309.57
Health	0.028	0.559	1770.91
Other checkpoints	0.006	0.112	354.816
Circulation	0.198	3.966	12564.28
TOTAL			**63363.17**

Table 2.2.2: Estimated surfaces according to FAA (international flights).

Nevertheless, due to our airport structure and preliminary design, some of these areas are going to be shared between domestic and international passengers. This will allow to tighten the space and reduce the extension of the terminal building, which will be too extense for the number of passengers at design hour.

Therefore, the final dimensioning of the airport will be as follows, shown in table **??**:

General (shared)	m2	Domestic	m2	International	m2
Departures	4725.56	**Waiting lobby**	5019.75	**Immigration**	2654.78
Arrivals	4724.56	**Circulation**	32475.6	**Customs**	5309.57
Restaurants	7082.83			**Health**	1770.91
Offices	21248.50			**Other checkpoints**	354.81
Other	2358.27			**Circulation**	12562.3
Restrooms	1419.77			**General circulation**	19456.36
Kitchens	7082.83			**Waiting lobby**	3009.60
TOTAL	**48641.34**		**37495.35**		**45131.33**

Table 2.2.3: Total surface distribution of terminal building.

The total surface of the terminal building area, dedicated to passengers and airport management is of 131267 m^2.

3 | Structural typology description

When it comes to building the terminal, it is important to specify which kind of materials are going to be used, and thus, the efforts that will hold the structure. In a general frame, it can be distinguished between two types of mechanisms of effort transmission to the foundation; firstly, the vertical efforts due to the gravitational load and, secondly, the lateral efforts due to the wind or possible earthquakes.

In the first case, the load-bearing elements work in compression and the ceilings work in bending-shear in the manner of a beam subjected to perpendicular loads in its plane.

In the second case, the same elements act differently. The ceilings receive and accumulate horizontal forces, working as a membrane and distributing forces between the different vertical elements, while the vertical elements work to bending-shear.

3.1 Foundation

Indonesia is a country with a very varied terrain due to the numerous geological faults combined with significant erosion. Volcanoes are the spine of Java. This irregular chain of volcanoes, which spread over the entire length of the island, forms the most active part of the 'Ring of Fire' volcano chain. The volcanism typical of Java's Island corresponds to the alkaline series, in which basalts, tephrites and phonolites predominate. Moreover, the zone is full of subterranean activity, earthquakes are fairly common. Most of them are not very powerful but it is very important to take into account this phenomena in terms of building the foundations.

The Island of Java is a region located in a area close to the coast, which implies the abundance of swampy land. Therefore, a deep foundation will be carried out in front of a medium or superficial one, since the superficial terrain will not be able to absorb the efforts that will transmit through a direct foundation.

3.2 Vertical elements

3.3 Forge

4 Indoor paving

4.1 Typology

4.2 Floor covering

4.2.1 Structural base

4.2.2 Intermediate layers without buttress function

4.2.3 Leveling layer

4.2.4 Grip layer

4.3 Design

4.4 Superficial layer

4.4.1 Common areas paving

4.4.2 Stairways

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4.4.4 Offices paving

4.4.5 Automatic baggage handling system paving

5 Facade

5.1 Front and back facade

5.1.1 Requirements and adopted solution

5.1.2 Glass

5.1.3 Spider system with steel pillars

5.1.4 Steel and concrete mixed columns

5.2 Lateral facade

5.2.1 Facade (prefabricated concrete)

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5.3.1 Main door and other sliding doors

5.3.2 Access bridges

5.3.3 Emergency doors

5.3.4 Automatic baggage handling system doors

6 Building cover

6.1 Adopted solution

6.2 Shape and inclination of the building cover

6.3 Used materials

6.4 Sewer system

7 Indoor closures

7.1 Walls

7.2 Doors

7.2.1 Baggage claim hall doors

7.2.2 Office access and automatic baggage handling system access doors

8 | Fire prevention regulations

8.1 Fire prevention regulations and chosen materials

8.1.1 Building elements

8.1.2 Materials

9 Bibliography